FORAGE CROPS FOR SWINE

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BULLETIN 242

OHIO AGRICULTURAL EXPERIMENT STATION

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FORAGE CROPS FOR SWINE

By B. E. CARMICHAEL and GEO. R. EASTWOOD

INTRODUCTION

Owing to high prices for grain feeds, the use of green feeds for swine is receiving increased attention from all who are interested in reducing the cost of pork production. While it has long been known that the use of green feeds very frequently lessens the cost of pork production, yet there has been a dearth of definite information concerning the relative value of the different crops suitable for this use in Ohio, and concerning the best methods of securing the full benefit from these crops. In order to secure data along this line, the Ohio Experiment Station has begun a series of experiments in which a small number of crops suitable for use with swine are being compared. The results of this work to date are presented in this bulletin. While much more work is needed to determine the relative efficiency of different forage crops, and the amount and character of grain rations that should be fed in connection with each of them, yet the results of the work to date should prove helpful in suggesting methods that will lower the cost of pork production. As in previous experiments, corn, on account of its relative cheapness, abundance and efficiency, was the basis of all rations used in the experiments reported in this bulletin.

The pigs used in these experiments were pure bred Duroc-Jerseys, bred at the Station. In selecting pigs for experimental purposes, the various lots used in each experiment were made as uniform in weight, age, breeding, and thrift as possible.

The grain feeds used in these experiments were ground. The tankage used was digester tankage, guaranteed to contain 60 percent protein. Proportions of feed are by weight. Concentrates were supplied in two equal portions daily, morning and evening, mixed with sufficient water to form a thick slop. The pigs were either watered frequently or had access to water at all times.

EXPERIMENT I

HOME GROWN SUPPLEMENTS FOR CORN

The fifteen pigs used in this experiment, which was conducted to compare pasture with other supplements produced on the farm, were young, growing pigs, averaging about 95 pounds each at the beginning of the experiment. These pigs were divided into five lots of three pigs each and were fed the following rations:

Lot 1 Corn, 1 part; skim milk, approximately 3 parts, in dry lot.
" 2 Corn, 4 parts; soybeans, 1 part, in dry lot.
" 3 Corn in dry lot.
" 4 Corn on mixed pasture.
" 5 Corn on clover pasture.

Each of the pastured lots had access to one-eighth of an acre. One-half of the clover plot was mowed before the pigs were turned in, so that this mowed part would supply fresh forage when the other part had been pastured down. The mixed pasture was chiefly timothy and blue grass. There was plenty of green forage in both lots throughout the test. All lots were fed as much grain as they would consume without waste. The experiment lasted 62 days, from June 24 to August 25, inclusive. The results of this test are shown in Table I.

TABLE I. EXPERIMENT I: 3 pigs in each lot. Test lasted 62 days, June 24 to August 25, 1909.

Lot	Ration	Initial weight	Final weight	Total gain	Average daily gain per pig	Total concentrates consumed	Average concentrates consumed daily per pig	Concentrates consumed per 100 lbs. gain
		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	Corn and skim milk in dry lot	291.	625.	334.	1.80	964.1 2879.5[2]	5.18[1] 15.48[2]	288.6[1] 862.1[2]
2	Corn and soybeans in dry lot.	275.5	542.8	267.3	1.44	834 4[1] 208.6[3]	4.49[1] 1.12[3]	312.2[1] 78.0[3]
3	Corn in dry lot	282.3	447.8	165.5	.89	877.3	4 72	530.1
4	Corn on mixed pasture.	285.	550.8	265 8	1.43	1134.	6.10	426.6
5	Corn on clover pasture.	284.	580.	296	1.59	1148.3	6 17	387.9

[1]Corn [2]skim milk [3]soybeans.

The lot fed corn and skim milk in dry lot made the most rapid gains. Results of other experiments in which skim milk was used to supplement corn in pork production, published in Bulletin 209 of this Station, show a high value for skim milk for this purpose. In the corn belt, however, skim milk is seldom available in sufficient quantities for extensive use in pork production. While corn and skim milk produced notably larger gains than did any of the other rations, yet wide differences prevail in the rate and cost of gains with the other rations. As is usually the case, corn alone in dry lot did not produce rapid nor economical gains. Corn and soybeans and corn and mixed pasture were of equal efficiency so far as rate of gain

is concerned, but the amount of corn, in addition to the pasture, required to produce 100 pounds gain was greater than the amount of corn and soybean mixture required in dry lot for the same gain. Clover pasture was especially efficient as a producer of both rapid and economical gains, and the general practice of making large use of clover pasture in summer pork production is indeed a sound one. Unfortunately, it is not always practicable to have clover for this use. If clover is not available, other green feeds, notably rape, may be used with excellent results. The results of experiments in which both rape and soybeans have been used are given on subsequent pages.

TABLE II. EXPERIMENT I: Replacement value of pasture and of supplemental feeds.

	Lot 1 Corn and skim milk in dry lot	Lot 2 Corn and soybeans in dry lot	Lot 3 Corn in dry lot	Lot 4 Corn on mixed pasture	Lot 5 Corn on clover pasture
Pounds of pork produced by 1 bushel of corn or its equivalent in cost[1]	13.4	13.0	10.6	12.6	13.8
Pounds of corn replaced by pasture and by supplemental feed per 100 pounds gain	28.	279.4		103.5	142.2
Replacement value of 1 acre of pasture and of 100 pounds of supplemental feed	$ .28	$ 2.79		$22.01	$33.67

[1]Corn, 56c per bushel; skim milk, 15c per cwt.; soybeans, $1.50 per cwt.; pasture, $4.00 per acre for 62 days.

Table II shows something of the importance of supplemental feeds for use in connection with corn, even though the purpose is to secure the greatest possible amount of pork "from a bushel of corn." It is shown that this can best be done by feeding in a way that will make possible an economical utilization of the corn. The common rule "Ten pounds of pork from a bushel of corn" should not apply in these days of high priced corn, and does not apply to results secured from the operations of the best feeders, even in dry lot, much less when good green feed is used.

Table III is of interest in showing something of the financial returns that would have been secured from the rations used in this experiment, under market conditions as defined in the table. It will be noted that both rate and cost of gains influence the profits from feeding operations. Market prices for feeds need to be considered with great care when rations are being chosen. The charge for pasture may seem high, but, on account of the fact that it was excellent pasture that had not been grazed earlier in the season, the charge is not far wrong. Be this as it may, both the mixed pasture and the clover pasture proved of high value as a supplement for corn, as is shown in Tables I, II, and III. These tables afford an opportunity to compare the results secured from efficient dry lot rations with those secured from corn in dry lot and from corn with two kinds of green feed—(1) clover and (2) mixed pasture.

TABLE III. EXPERIMENT I: Influence of varying market prices for corn.

Rations	Corn, 1; skim milk, 3, in dry lot	Corn, 4; soybeans, 1, in dry lot	Corn in dry lot	Corn on mixed pasture	Corn on clover pasture
Corn 42c per bu.; soybeans 90c per bu.; skim milk 15c per cwt.; pasture $4 per acre for 62 days.					
Cost per 100 pounds gain	$3.46	$3.51	$3.98	$3 39	$3.08
Profit on gain in live weight per hog at 6c per pound	2.83	2.22	1.12	2.31	2.88
Corn 56c per bu.; soybeans 90c per bu.; skim milk 15c per cwt.; pasture $4 per acre for 62 days.					
Cost per 100 pounds gain	$4.18	$4.29	$5.30	$4.45	$4.05
Profit on gain in live weight per hog at 6c per pound	2.03	1.52	.39	1.37	1.92
Corn 70c per bu.; soybeans 90c per bu.; skim milk 15c per cwt.; pasture $4 per acre for 62 days.					
Cost per 100 pounds gain	$4.90	$5.07	$6.63	$5.52	$5.02
Profit on gain in live weight per hog at 6c per pound	1.22	.83	[1]—.35	.43	.97

[1]Loss

EXPERIMENT II

CLOVER, RAPE, SOYBEANS AND BLUEGRASS VS. DRY LOT

Experiment II was conducted during the summer of 1910, beginning July 16 and lasting 76 days. The rainfall in this section during this period was very light (only 3.17 inches was recorded from July 16 to September 15 by Mr. C. A. Patton, Station Meteorological Observer) an amount insufficient for an average growth of the forage crops used in this test. All lots in this test were fed as much ground corn as they would consume without waste. The pigs in Lot 1 were confined to a 10 ft. x 12 ft. pen in the hog barn and a 10 ft. x 40 ft. outside pen. Each of the pastured lots was allowed to graze on a one-eighth acre plot of forage, except the clover lot, which had access to one-fourth of an acre from which a hay crop had been harvested some time earlier. The results of this experiment are shown in Table IV.

TABLE IV. EXPERIMENT II: 3 pigs in each lot; test lasted 76 days, July 16 to September 29, 1910, inclusive.

Range (All lots fed corn)	Initial weight	Final weight	Total gain	Average daily gain per pig	Total corn consumed	Average corn consumed daily per pig	Corn consumed per 100 lbs. gain	Corn replaced per 100 lbs. gain by pasture	Replacement value of one acre of pasture. (Corn 56c per bushel)
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Dry lot	291.3	566.8	275.5	1.21	1234.5	5.41	448.1		
Bluegrass and white clover	279.5	593.2	313.7	1.38	1333.	5.85	424.9	23.2	$ 5.82
Rape	277.7	608.7	331.0	1.45	1271.5	5.58	384.1	64.0	16.95
Soybeans	282.2	633.3	351.1	1.54	1385.	6.07	394.5	53.6	15.06
Red clover[1]	290.2	677.5	387.3	1.70	1459.	6.40	376.7	71.4	11.06[1]

[1]Second crop.

All lots in this test made very good gains. Lot 1, fed corn alone in dry lot, made larger gains and required less feed per pound of gain than usual for pigs of this age when fed corn alone in dry lot.

On account of the extreme drought previously mentioned, all of the forage plots made a relatively poor showing. Such conditions do not often prevail, however. It is of interest to note that a more rapid gain was made by the lots that had green feed than by the lot kept in dry lot, and that a smaller amount of corn was required to produce a given gain.

It will be noted that clover produced the most rapid gains. In addition to this, the lot on clover required less corn for a given gain than did any of the other lots.

The low replacement value per acre for clover is due to the fact that this was second crop clover. Rape and soybeans were not greatly different in efficiency, and either was much better than bluegrass, which was the poorest of the green feeds that were used. It should be remembered in this connection that the weather conditions were especially unfavorable to bluegrass, which seems more susceptible to drought than do the other crops used in this test.

EXPERIMENT III

RAPE AND SOYBEAN PASTURE VS. DRY LOT, AND CORN VS. CORN AND TANKAGE, ON RAPE PASTURE

The forage plots used in this test were seeded May 24. One-half of each plot was seeded in rows 24 inches apart and the other half was drilled solid. Plot 4 of rape contained 49.4 square rods, approximately 10 square rods more than either Plots 2 or 3 of soybeans and of rape which contained 39.3 and 38.6 square rods, respectively. The forage in these plots was about 10 inches high when the test began. Some idea of the appearance of these plots at this time can be had from Figures 1, 2 and 3 (page 560). Lot 1, fed in dry lot, had access to a 10 ft. x 12 ft. pen in the hog barn and a 10 ft. x 40 ft. outside pen.

The pigs used in this test were weaned at 8 weeks of age and put on this test when they were from 12 to 13 weeks old and weighed an average of 44.6 pounds per pig. These pigs were fed the same ration, both while they were with their dams and during the few weeks after they were weaned, previous to the test.

The pigs were divided into four lots and fed as follows:

Lot 1 Five pigs fed corn, 9; tankage, 1, in dry lot.
" 2 Six pigs fed corn, 9; tankage, 1, on soybean pasture.
" 3 Six pigs fed corn, 9; tankage, 1, on rape pasture.
" 4 Eight pigs fed corn on rape pasture.

The pigs in dry lot were given all the feed they would consume without waste, while those in the forage plots were fed a limited grain ration—sufficient to produce a fair rate of gain and at the same time leave them with a good appetite for the forage.

During the early part of this test there were a few cases of sore ears in the lots pastured on rape. These sore ears were washed with a disinfecting solution and treated with vaseline. After one or two such treatments the trouble disappeared.

The pigs on soybean pasture were put in dry lot and those on Rape Plot 3 changed to half of Rape Plot 4 on September 29. At this time the feed in the soybean plot was exhausted, but there was still some rape in Plot 3, although it was a very small amount. Rape Plot 4, which was in a much higher state of fertility than Plots 2 and 3, contained at this time an abundance of forage, more than the seven pigs then in the lot would have eaten before cold weather. This plot was divided into two equal parts and Lot 4 was placed in one-half while Lot 3 was placed in the other. The rape in this plot held out remarkably well, supplying a liberal amount of forage until the latter part of October, when the weather became too cold for the rape to grow.

Owing to the larger growth of the forage in Plot 4, the results from this plot are not comparable in a very definite way with those from Plots 2 and 3, and this point should be borne in mind when the results of this test are studied. Figures 4, 5 and 6 (page 561) afford an interesting comparison of the relative amount of forage in the three different plots 48 days after the test began. The returns from Plot 4 show something of the importance of using very fertile land for the growing of green crops for this use.

TABLE V. EXPERIMENT III: Average daily feed consumed per 100 pounds live weight and average daily gain per pig for each week.

Week ending	Lot 1 Corn, 9; tankage, 1, in dry lot		Lot 2 Corn, 9; tankage, 1, in soybean pasture[1]		Lot 3 Corn, 9; tankage, 1, on rape pasture, Plot 3[2]		Lot 4 Corn on rape pasture, Plot 4	
	Av. concentrates consumed daily per 100 lbs. live weight	Av. daily gain per pig	Av. concentrates consumed daily per 100 lbs. live weight	Av. daily gain per pig	Av. concentrates consumed daily per 100 lbs. live weight	Av. daily gain per pig	Av. concentrates consumed daily per 100 lbs. live weight	Av. daily gain per pig
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
July 21	3.90	.07	3.30	.60	3.31	.61	3.28	.57
28	3.92	.49	2.80	1.02	2.81	.73	3.00	.57
Aug. 4	3.71	.51	2.64	.55	2.74	.77	2.97	.99
11	3.62	.47	2.47	.76	2.50	.73	2.61	.55
18	3.49	.45	2.27	.62	2.30	.76	2.45	.54
25	3.37	.52	2.49	.95	2.48	1.26	2.69	1.06
Sept. 1	3.86	.77	2.60	.25	2.52	.83	2.76	1.11
8	3.57	.57	3.39	1.04	2.01	.79	2.49	.91
15	3.64	.79	4.35	1.08	2.21	1.12	2.31	.79
22	3.66	.86	4.63	1.23	2.03	.48	2.01	.47
29	4.15	1.04	4.71	1.26	2.74	.71	2.81	.94
Oct. 6	4.21	1.13	4.61	1.63	2 81	1.63	2.84	1.34
13	4.30	1.25	4 49	1.48	2.78	1.08	2.86	1.59
20	3.83	.98	4.14	1.06	3.29	1.02	3.27	.99
27	3.76	1.21	4.14	1.71	3.85	1.48	3.73	1.31
Nov. 3	3.59	1.04	3.50	1 80	4.09	1.32	4.05	1.05
10	3.67	1.63	4.10	1.57	4.21	1.89	4.27	1.69

[1]Placed in dry lot September 29.

[2]Placed in half of rape plot occupied by Lot 4, September 29.

Table V shows the average daily concentrates consumed per 100 pounds live weight (based on the weights of the different lots at the beginning of each week) and the average daily gain per pig for each week.

A summary of the results of this test is shown in Table VI. Part I shows the results from the beginning of the test to September 29, when Lot 2 was put in dry lot and Lot 3 changed to half of Plot 4. Part II shows the results from September 29 to the close of the test, November 10. Part III is a summary of the entire test.

Lot 1 did not develop a very large capacity for feed. The pigs in this lot made an economical use of their feed, but the total amount of feed consumed was small. They did not develop the growthy appearance exhibited by the pigs on the forage plots, and showed slightly more of a tendency to fatten at a light weight and in a short time than did the pigs on the forage plots.

TABLE VI. EXPERIMENT III: Test lasted 119 days—July 15 to November 10, 1911

Part I: Lasted 77 days--July 15 to September 29

Lot	Number pigs in lot	Ration	Initial weight	Final weight	Total gain	Av. daily gain per pig	Total concentrates consumed	Av. concentrates consumed daily per pig	Concentrates consumed per 100 lbs. gain
			Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	5[1]	Corn 9, tankage 1, dry lot.	230.5	377	191.5	.58	781.0	2.36	407.8
2	6	Corn 9, tankage 1, soybean pasture.	273.0	666	393.0	.85	1121.0	2.43	285.2
3	6	Corn 9, tankage 1, rape pasture.....	272.0	641	369 0	.80	825.0	1.79	223.6
4	8[2]	Corn alone, rape pasture.....	340.0	739	467.0	.77	1082 5	1.79	231.8
		Part II: Lasted 42 days—September 30 to November 10.							
1	4	Corn 9, tankage 1, dry lot...	377	579.5	202.5	1.21	741	4.41	365.9
2	6[3]	Corn 9, tankage 1, dry lot.....	666	856.0	365.0	1.54	1375	5.80	376.7
3	6	Corn 9, tankage 1, rape pasture[4]...	641	995 0	354 0	1.40	1169	4.64	330.2
4	7	Corn alone, rape pasture[4]	739	1129.5	390.5	1.33	1348	4.59	345.2
		Part III: Summary of Parts I and II.							
1	5[1]	Corn 9, tankage 1, dry lot.....	230.5	579.5	394.0	.79	1522.0	3.05	386.3
2	6[3]	Corn 9, tankage 1, soybean pasture[5]	273.0	856.0	758.0	1.08	2496.0	3.57	329.3
3	6	Corn 9, tankage 1, rape pasture[4]...	272 0	995 0	723.0	1.01	1994.0	2.79	275.8
4	8[2]	Corn alone, rape pasture[4]	340.0	1129.5	857.5	.95	2430.5	2.71	283.4

[1] Pig taken out August 7, weight 45 pounds. [2] Pig taken out September 18, weight 68 pounds.
[3] Pig taken out October 27, weight 175 pounds. [4] In half of Plot 4 after September 29.
[5] In dry lot after September 29.

Lot 2, fed corn, 9 parts; tankage, 1 part, on soybean pasture, made slightly larger gains and required considerably more grain per 100 pounds of gain than did Lot 3, fed the same mixture on rape pasture. This larger grain requirement per 100 pounds of gain by Lot 2, however, is due largely, if not entirely, to the scant supply of forage and the heavier grain ration received by this lot during the four weeks preceding the close of Part I of the test.

Lot 4, fed corn alone on rape pasture, required slightly more grain per 100 pounds gain and made gains at a slightly lower rate than did Lot 3, during both parts of the test. The difference, however, is small, and, on account of the difference in the growth of forage pastured by these lots during the first part of the test, these figures cannot be considered conclusive. Both lots made very satisfactory gains, requiring less than 3 pounds of concentrates per pound of gain and making gains at the rate of approximately 1 pound daily per pig. There were wide variations in amount of feed required for a given gain in dry lot and on forage during the first part of the test. These variations show something of the great saving that may be effected by using forage crops in pork production.

Lot 2, when in dry lot during the second part of the test, consumed considerably more grain daily per pig, made more rapid gains, but required 10.8 pounds more feed per 100 pounds of gain than did Lot 1, fed in dry lot through the entire test. Each of these lots showed a low feed requirement per 100 pounds gain during this part of the test. The difference is not large, and more work along this line is needed before a definite statement can be made concerning the effect of grazing and dry lot feeding upon subsequent gains.

The results of this test indicate that corn alone is almost as efficient for use with abundant rape pasture as is a mixture of corn and tankage.

There seemed to be more growth with the lot fed corn and tankage than with the lot fed corn alone, but the rate of gain and amount of feed required for a given gain did not show that the corn and tankage mixture was much more efficient than was corn alone. Further work along this line is needed before definite conclusions are jusified. It seems entirely probable that maximum gains could be secured by the use of a smaller proportion of supplemental feed with corn when feeding on rape than when feeding in dry lot.

The replacement value per acre of forage from the different plots and rations, based on the amount and cost of grain replaced by forage, as compared with Lot 1, and on the assumed prices of 56c per bushel for corn and $48 per ton for tankage, is as follows: Plot 2, soybeans, $22.37; Plot 3, rape (with corn and tankage mixture) $32.13; Plot 4, rape (with corn) $35.22. This value of $35.22 per acre for Plot 4 represents the replacement value of rape grown on this plot and consumed by Lot 4 during the first part of the test. Adding to this the replacement value per acre yielded by this plot when occupied by Lots 3 and 4 during the second part of the test, a total replacement value of $48.97 per acre for rape in this plot is shown.

Table VII gives the composition of rape and soybeans from the plots used in this experiment, as reported by the Department of

Chemistry of this Station. For purposes of comparison, the average analysis of fresh clover, bluegrass and timothy as given in Henry's "Feeds and Feeding" is also given. Since widely different proportions of water are carried by the green forage from these crops, a comparison on dry matter basis is given in the second part of the table. It will be noted that rape was higher in protein than either soybeans or clover, when compared on a dry matter basis. Its very low crude fiber content is another point in favor of rape, since coarse, fibrous feeds are not suitable for swine. The high protein content of dwarf Essex rape gives it a place in feed classification that has not always been accorded it. There has been a rather general opinion that only leguminous plants carry large proportions of protein, even in the green state. Rape furnishes a notable example of the inaccuracy of this opinion, and the figures presented in Table VII will go far towards explaining the high efficiency shown by rape in experiments conducted at this Station.

TABLE VII. Percentage composition of rape, soybeans, clover, bluegrass and timothy.

Calculated to fresh sample.

Description of sample	Water	Dry matter	Ash	Fiber	Protein	Nitrogen free extract	Fat
Soybeans (sample from Plot 2, Exp. III)..	72.28	27.72	2.22	8.08	4.86	12.25	.31
Rape (Sample from Plot 3, Exp. III).....	87.14	12.86	1.51	2.38	2.50	6.21	.26
Rape (Sample from Plot 4, Exp. III).....	88.55	11.45	1.51	2.06	2.48	5.21	.19
Clover (Henry's "Feeds and Feeding").....	70.80	29.20	2.10	8.10	4.40	13.50	1.10
Bluegrass (Henry's "Feeds and Feeding")	65.10	34.90	2 80	9.10	4.10	17.60	1.30
Timothy(Henry's "Feeds and Feeding")..	61.60	38.40	2.10	11.80	3.10	20.20	1.20
Calculated on dry matter basis.							
Soybeans (Sample from Plot 2, Exp. III)..	....	27.72	8.01	29.15	17.53	44.19	1.12
Rape (Average of above two samples).....	....	12.16	12.42	18.26	20.48	46.96	1.89
Clover (Henry's "Feeds and Feeding")..	....	29.20	7 19	27.74	15.07	46.23	3.77
Bluegrass (Henry's "Feeds and Feeding")	....	34.90	8.02	26.07	11.75	50.43	3.72
Timothy (Henry's "Feeds and Feeding")	....	38.40	5.47	30.73	8.07	52.60	3.13

In each of these plots, the half which was seeded in rows and cultivated, produced more vigorous growth of forage than did the half which was drilled solid. Whether or not the additional growth secured by seeding in rows and cultivating will justify the extra labor involved will depend a great deal on the character of the soil and the probability of weeds getting a start in the forage. In the lower portions of Plots 2 and 3 the weeds became large in the forage on the part seeded solid. In Plot 4, which was higher and better drained, no difficulty from weeds was experienced, and the difference in growth of forage on the part sown in rows and cultivated and the part sown solid was not so great. Some of these differences can be noted in the Figures on pages 560 and 561.

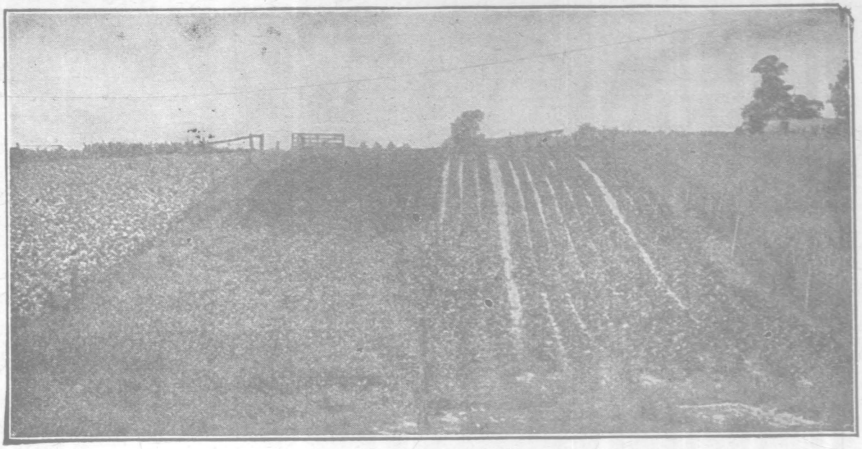

Fig. 1. Soybeans, Plot 2, at beginning of experiment July 14, 1911.

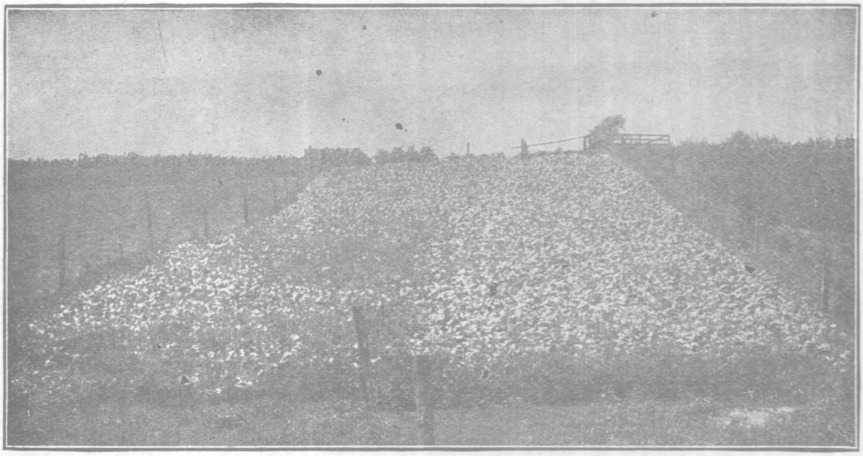

Fig. 2. Rape, Plot 3, at beginning of experiment July 14, 1911.

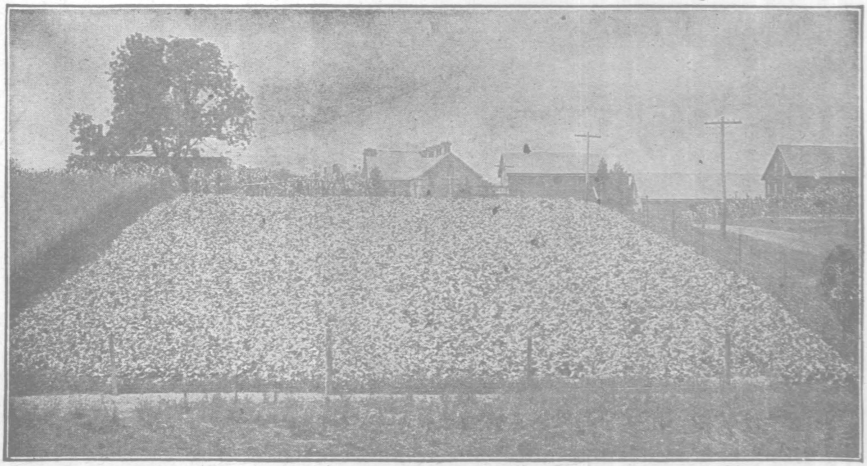

Fig. 3. Rape, Plot 4, at the beginning of the experiment July 14, 1911.

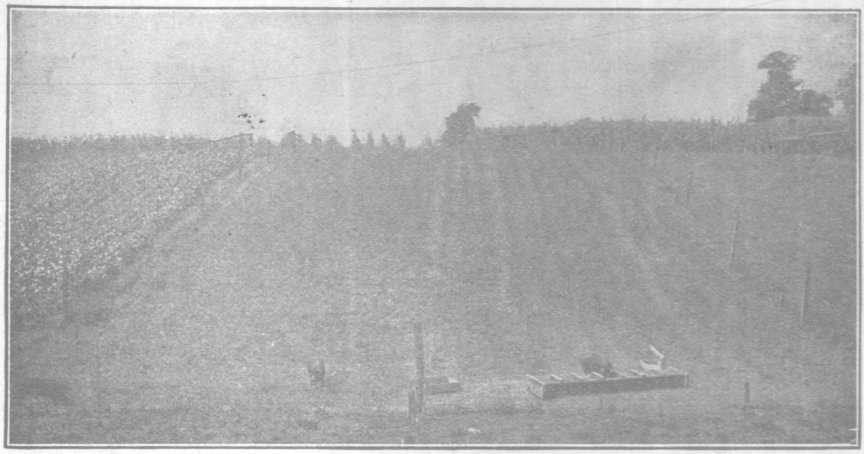

Fig. 4. Soybeans, Plot 2, August 31, 1911, 48 days after beginning of experiment.

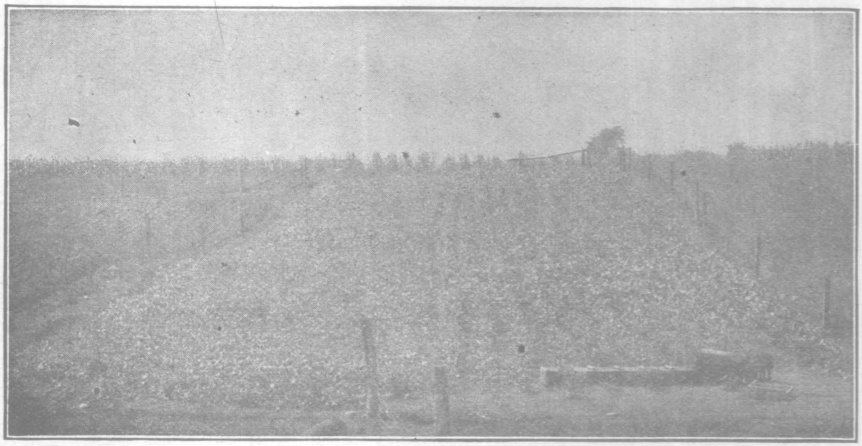

Fig. 5. Rape, Plot 3, August 31, 1911, 48 days after beginning of experiment.

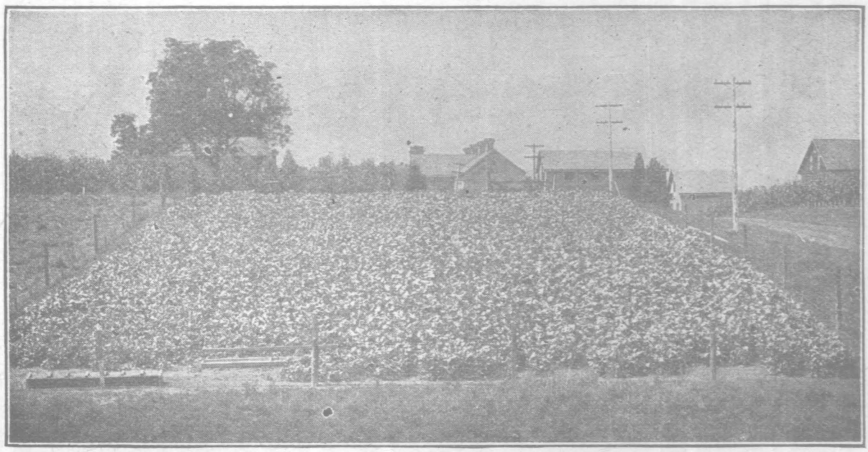

Fig. 6. Rape, Plot 4, August 31, 1911, 48 days after beginning of experiment.

The difference in the amounts of forage produced by Plots 3 and 4 and the greater returns from Plot 4, which was in a comparatively high state of fertility as compared with Plot 3, indicate that abundant fertilization of the soil for rape is well worth while. Feed lots that are vacant for the summer, or other similar small areas, can frequently be utilized to good advantage in the growing of forage crops.

The following recommendations for seeding rape and soybeans are made by Prof. C. G. Williams, Chief in Agronomy at this Station:

"Rape may be sown from April 1 to July 15. If drilled in rows 24 to 28 inches apart, 3 to 4 pounds of seed, and if drilled solid, 5 to 7 pounds of seed per acre should be used. The seed may be run through the grass seeding attachment of an ordinary grain drill and piped back through the hoes of the drill. Dwarf Essex is the best variety of rape for forage.

"Soybeans may be sown from May 20 to June 10. When drilled in rows 24 to 28 inches apart, 2 to 3 pecks of seed per acre, and when drilled solid, 6 to 8 pecks per acre are recommended."

EXPERIMENT IV

DIFFERENT PROPORTIONS OF CORN AND TANKAGE ON MIXED PASTURE

Sixteen pigs were divided into two uniform lots and fed on pasture consisting chiefly of bluegrass and timothy. One lot was fed a grain ration of corn, 9 parts; tankage, 1 part, the other lot was fed corn, 19 parts; tankage, 1 part. The results of this test are shown in Table VIII.

The green feed available for these lots was not very abundant at any time, as the pigs kept it grazed down very closely. These pigs had access to 64.8 square rods of pasture, which was divided into two nearly equal plots. On account of the fact that there was more grass in one plot than in the other, the pigs were changed from one plot to the other at the end of each week, so that at the end of the twenty weeks each lot of pigs had pastured ten weeks on each of the plots.

TABLE VIII. EXPERIMENT IV. 8 pigs in each lot; test lasted 140 days, July 13 to November 29, 1911.

Grain ration	Initial weight	Final weight	Total gain	Av. daily gain per pig	Total concentrates consumed	Av. concentrates consumed daily per pig	Concentrates consumed per 100 pounds gain	Cost[1] of concentrates consumed per 100 pounds gain
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs	Lbs.	Lbs.	
Corn, 9; tankage, 1	377.5	1783.	1405.5	1.25	5274.5	4.71	375.3	$4.28
Corn, 19; tank., 1	391.0	1721.	1330.0	1 19	5179.5	4.62	389.4	4.17

[1]Corn, 56 cents per bushel; tankage, $48 per ton.

During the first ten or twelve weeks of this test the pigs were fed slightly less concentrates than they would have consumed had

they been given access to more. During the latter part of the test, when there was less green feed available in these plots, both lots were fed all the concentrates they would consume without waste.

Both lots of pigs made satisfactory gains. The difference in the rate of gains and in the amount of concentrates required for a given gain by the two lots was small. The lot fed the larger proportion of tankage made slightly larger gains and required slightly less feed per 100 pounds gain than did the lot fed the ration consisting of corn, 19 parts; tankage, 1 part. Although the ration consisting of corn, 9 parts; tankage, 1 part, was slightly more efficient in producing gains in this test than the one carrying the smaller proportion of tankage, the difference shown is small, and these results should be verified by more work along this line before they are accepted as conclusive evidence of the relative efficiency of the two rations.

OTHER FORAGE CROPS

Three other forage crops, (1) sowed corn, (2) sorghum, and (3) Canada field peas and oats sown together, were used in a test that was interrupted in such a way as to prevent a definite statement of results. This test indicated, however, that none of these crops is as useful as clover, rape or, probably, soybeans. Peas and oats tangle badly and are wasted by trampling. After being fed off, neither corn nor sorghum continued in growth in a way that would supply a generous amount of succulent feed for a long time. Green forage crops for swine should have a habit of persistent growth, and should produce a large amount of succulent, palatable leaf, without much coarse, woody stalk or stem. It is also of distinct advantage for the crop to start in early spring and continue until late in the fall, although a succession of crops could be used to supply early, medium and late feed, if it seemed desirable to use single crops that would not do this.

This Station has had no opportunity to use alfalfa in an experimental way in pork production. However, the results of experiments at other Stations[1] and the experience of Ohio feeders who have used it show that alfalfa is a highly valuable green feed for swine. Wherever it does well and will endure pasturing it would be expected to show a forage value higher than that of red clover. Close pasturing of alfalfa is not recommended, as it is likely to kill the alfalfa, even when light pasturing, in connection with mowing as usual, could be practiced satisfactorily.

[1]Buls. 75, 123, Neb. Exp. Sta. Bul. 95, Mo. Exp. Sta.

MANURE

An important consideration that is too often overlooked is the economical utilization of manure produced by swine. Dry lot feeding in summer is often associated with a heavy waste of manure from hogs on account of the large part of the manure that is leached or blown away when deposited in bare lots. Feeding on pasture or in cultivated fields will do much to obviate this loss, since a large proportion of the droppings and urine will then be deposited in the field where the fertilizing constituents may be utilized.

CONCLUSIONS

Green forage has a high value for use in pork production.

Spring sown crops cannot take the place of earlier sources of green feed for swine, but should be used to supplement them.

Data secured by this Station indicate that the green feeds used in experiments rank as follows in order of efficiency: red clover, dwarf Essex rape, soybeans, bluegrass.

Seasonal influences have an important effect upon the value of forage crops. Owing to the fact that spring planted crops are not subject to these influences for the entire year, they have, in respect to these influences, some advantages over such crops as bluegrass and clover. Bluegrass, on account of its being particularly susceptible to drought, is not so useful for midsummer use as are some other crops.

The use of green feeds in connection with corn will diminish the need for nitrogenous concentrates that exists in dry lot feeding, but to what extent has not yet been determined. Neither do the data at hand show what amount of grain feed should be used in connection with green feeds. Additional data are needed to show what rations, in kind and amount, are best for use in connection with green feeds. Green feeds alone should not, of course, be expected to produce rapid gains.

Further work along this line is under way and will be reported later.

ACKNOWLEDGMENT

The authors are glad to acknowledge the valuable assistance rendered by Mr. R. E. Caldwell, Assistant in Animal Husbandry from February, 1909, to August, 1910; Mr. Caldwell took an important part in planning and conducting the experiments carried on between these dates.

Note:—During the season of 1912 an abnormal condition of rape grown on and near plots used in 1911 for this crop materially shortened the period of growth and lessened the yield of green forage. The Experiment Station is studying this trouble. Pending the results of these studies, it would seem wise to avoid growing rape on the same land two or more years in succession. Although it is not certain that this precaution would prevent the occurrence of this trouble, it is probable that the continuous growing of rape on the same land would provide conditions suitable for its extensive spread.